BRAKE SYSTEM DIAGNOSTICS USING A HAND-HELD RADIO DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Number 60/258,664 filed December 29, 2000, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] This invention relates generally to train braking systems, and more particularly to evaluating the operational status of brakes on an individual railcar.

[0003] A train consist typically includes a lead locomotive and one or more remote locomotives, and railcars, comprehensively referred to as rolling stock. Each piece of rolling stock has braking equipment including, among other components, a section of brake pipe, a feed valve, and a brake cylinder. The brake pipe sections are connected forming a brake pipe that extends the length of the consist. When the feed valve of a brake pipe section is cut-in air pressure in the brake pipe is increased disengaging the brakes, and when the feed valve is cutout air is released or exhausted from the brake pipe and the brakes engage. To apply train brakes the brake pipe pressure decreases at a specified rate, which determines the percentage of brake applied.

[0004] Proper functioning of the braking system for each piece of rolling stock in a train consist is important in maintaining safe and efficient operation of the consist. Improper functioning of braking equipment in a train consist may cause loss of efficiency, for example, excessive fuel consumption and increased wear on wheels and brake shoes. Additionally, improper brake functioning can create unsafe conditions, such as high in-train forces and increased risk of train separations

when all braking equipment is not working simultaneously. Thus, regular brake equipment testing, diagnostics and maintenance are required.

[0005] At present, to test the brake system of a piece of rolling stock, the individual piece of rolling stock is removed from the train consist and pneumatic test equipment is connected to the rolling stock. Therefore, to isolate a failed brake system component, or verify the braking system is operable, each piece of rolling stock in the train consist must be disconnected, tested, repaired if necessary, and re-connected to a train consist. Furthermore, presently there is not an efficient way to forward information reports containing information, such as consist condition and disposition, to a central location where owners of the rolling stock can obtain pertinent information.

BRIEF DESCRIPTION OF THE INVENTION

[0006] In one aspect, a method is provided for diagnosing a braking system using a system including a radio-based hand-held analyzer, at least one radio-based feed valve, and at least one mobile data unit. The braking system includes at least one brake pipe section, a reservoir, and at least one brake cylinder. The brake pipe section connects to the reservoir, the brake cylinder, and the radio-based feed valve. The hand-held radio-based analyzer communicates with the mobile data unit and the radio-based feed valve. The method includes retrieving brake system data and information using the hand-held analyzer, interpreting the retrieved data and information, and performing maintenance functions based on the interpretation of the data and information.

[0007] In another aspect, a system is provided for diagnosing a braking equipment, wherein the braking equipment includes at least one brake pipe section connected to a reservoir and at least one brake cylinder. The system includes a radio-based hand-held analyzer, at least one radio-based feed valve connected to the brake pipe section and configured to communicate with the hand-held analyzer, and at least one mobile unit configured to communicate with the hand-held analyzer.

[0008] In a further aspect, a hand-held analyzer is provided for testing and diagnosing a brake system including a radio-based feed valve. The hand-held analyzer includes an antenna for communicating with the feed valve, a user interface for inputting data and commands to be communicated to the feed valve, and a display for viewing data received from the feed valve. The hand-held analyzer is configured to utilize said user interface to input a command to query the feed valve for brake system data indicative of an operational state of the brake system, transmit the query to the feed valve utilizing the antenna, receive the brake system data indicative of an operational state of the brake system utilizing the antenna, and display the brake system data on the display.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a schematic of a system for testing and analyzing brake equipment in accordance with one embodiment of the present invention.

[0010] Figure 2 is a schematic of a server system for testing and analyzing brake equipment, used in conjunction with the system shown in Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Figure 1 is a schematic of a system 10 for testing and diagnosing braking equipment of a train consist (not shown). System 10 includes a radio-based hand-held brake analyzer 12, at least one radio-based feed valve 14, at least one mobile data unit 16, and a brake pipe 18 extending along the consist. Brake pipe 18 includes a plurality of brake pipe sections 22 for supplying and venting air during operation of at least one brake cylinder 26. Brake pipe sections 22 are connected by trainline hoses (not shown) to form brake pipe 18. Each locomotive and railcar in the train consist includes a respective brake pipe section 22 connected to brake cylinder 26, and a reservoir 34 for storing compressed air used during operation of brake cylinder 26. Additionally, each brake pipe section 22 is connected to radio-based feed valve 14, which controls the flow of air in the respective brake pipe section 22, thereby controlling air pressure in brake cylinder 26 and a respective reservoir 34.

Furthermore, system 10 includes an exhaust 38 connected to brake pipe section 22 for exhausting air from brake pipe section 22. Exhaust 38 includes an exhaust valve 42 for controlling the flow of air through exhaust 38. Mobile data unit 16 includes a processor 46 for executing all functions of data unit 16 and an electronic storage device 50 for storing information, programs and data. Hand-held analyzer 12 includes a display 54 for displaying information and data, a user interface 58 for inputting data and commands, and an antenna 62

[0012] In one embodiment, radio-based feed valve 14 includes a sensor 64 and a processor 68. Sensor 64 senses and measures pressure in brake pipe 18, pressure in brake pipe section 22, reservoir 34, and pressure in brake cylinder 26. Processor 68 processes the pressure measurements, compiles brake system data, and communicates, via a radio frequency, with hand-held analyzer 12. More specifically, in addition to controlling the air flow in brake pipe section 22, feed valve 14 monitors pressures in the braking system of an individual piece of rolling stock indicative of the operational state of the braking system, i.e. brake pipe section 22, brake cylinder 26 and reservoir 34.

[0013] A user, such as a brakeman, utilizes hand-held analyzer 12 to test and diagnose the functional state of the braking system without disconnecting the piece of rolling stock from the train consist. Hand-held analyzer 12 communicates with valve 14 via radio communications. Using interface 58, a user enters an identification number specific to the piece of rolling stock braking system to be tested, then enters commands, and data to query valve 14 for brake system data, such various component pressures, and to test the brake system. In response to the query, valve 14 communicates pressure measurements of brake system components, such as brake pipe section 22, brake cylinder 26 and reservoir 34, to hand-held analyzer 12. The information and data received from valve 14 is displayed on display 54 for viewing by the user, and used to diagnosis the operational state of the braking system of the piece of rolling stock. Based on the diagnosis, the user determines whether or not repairs are needed and the appropriate maintenance procedures necessary to implement any needed repairs. For example, nearby pieces of rolling stock should have similar

pressure readings, therefore if pressure readings from a piece of rolling stock vary from the pressure reading of nearby pieces of rolling stock, the user can quickly isolate a leaky brake system component such as cylinder 26, reservoir 34, and brake cylinder 26. Once a leaky component is isolated, the user can implement maintenance procedures to correct the faulty component, such as removing the piece of rolling stock from the consist to a side track for repair and reconnecting the rolling stock once repairs are completed.

[0014] In another embodiment, feed valve 14 monitors pressure changes in brake system components, such as brake pipe section 22, brake cylinder 26, and reservoir 34. A user then utilizes held analyzer 12 to query valve 14 for information pertaining to changes in pressure that exceed a specified range. If pressure fluctuations in the brake system exceed the specified range, the user analyzes the information and initiates proper adjustments or repairs.

[0015] In yet another embodiment hand-held analyzer 12 includes a processor 72 and an electronic memory module 76. Via radio communications with feed valve 14 and operation of user interface 58, hand-held analyzer 12 receives and stores brake system data inputs and other general information inputs, such as an employee identification, an identification number for a specific piece of rolling stock, and the related failure conditions, tests performed on the braking system, type of repairs needed, type of repairs performed in the past, a billing code, sided location. Processor 72 processes and compiles this data and information, which is then stored in memory module 76. At a later time the information and data stored in memory module 76 is downloaded to mobile data unit 16 using a communications link, such as the Internet, radio frequency, direct wire communications, and direct optical communications. In an alternate embodiment, mobile data unit 16 broadcasts the information and data over a local communications backbone, such as a local area network (LAN), or a wide area network (WAN), which is then posted to a password protected web page.

[0016] Figure 2 is a schematic of a server system 100 for testing and diagnosing the operational state of braking equipment, used in conjunction with

system 10 (shown in Figure 1). In an alternate embodiment, mobile data unit 16 (shown in Figure 1) is part of a computer network accessible using the Internet. Server system 100 is an automated system that includes a server 114 and a plurality of client systems 118 connected to server 114. In one embodiment, client systems 118 includes a computer (not shown), such as mobile data unit 16 (shown in Figure 1), including a web server, a central processing unit (CPU), a random access memory (RAM), an output device, for example a monitor, a mass storage device, and an input device, for example a keyboard or a mouse. In an alternative embodiment, client systems 118 are servers for a network of customer devices.

[0017] Server 114 is accessible to client systems 118 via the Internet. Client systems 118 are interconnected to server 114 through many interfaces including dial-in-connections, cable modems, special high-speed ISDN lines, and networks, such as local area networks (LANs) or wide area networks (WANs). In one embodiment, client systems 118 includes any client system capable of interconnecting to the Internet including a web-based phone or other web-based movable equipment. Server 114 is also connected to mass storage device 122. Mass storage device 122 is accessible by potential users through client systems 118.

[0018] The braking system of a specific piece of rolling stock is tested and diagnosed while it remains connected to the train consist using the hand-held analyzer. The hand-held analyzer communicates with the radio-based feed valve, transmitting queries pertaining to the functional status of the braking system of the piece of rolling stock. The radio-based feed valve monitors air pressure in brake system components of the piece of rolling stock, such as the brake pipe sections, the brake cylinder, and the reservoir, communicates the information to the radio-based hand-held analyzer. Therefore, the functional state of the braking system of an individual piece of rolling stock can be tested and diagnosed without the added time and expense of disconnecting the rolling stock from the train consist.

[0019] While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.